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and F. William Knott

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Pat O. Currie, Range Scientist
Carleton B. Edminster, Mensurationist
and
F. William Knott, Forestry Technician
Rocky Mountain Forest and Range Experiment Station[1]

Abstract

Effects of cattle grazing on ponderosa pine regeneration were evaluated on pine-bunchgrass ranges in central Colorado. Good range management practices of grazing at light to moderate rates and providing adequate water supply to livestock resulted in negligible damage to natural and artificial regeneration.

A single planting of 1,200 seedlings per acre, or an initial planting of 500 to 600 seedlings per acre and replanting areas of high mortality is recommended to increase pine regeneration.

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[1] *Central headquarters maintained at Fort Collins in cooperation with Colorado State University.*

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Management Implications

Multiple-use is a key consideration in the management of forested rangelands in the montane zone of central Colorado. These lands are heavily used for camping, picnicking, fishing, hunting, hiking, and sightseeing. A key to maintaining and enhancing these activities in esthetically pleasing surroundings is the effective use of commodity producing resources for local employment, shelter, and food.

The open-growing ponderosa pine (*Pinus ponderosa* var. *scopulorum* Engelm.) forests are characterized by variations in stand density, age class distribution, size of patches of uniform density and age structure, and size of forest openings (fig. 1). These conditions can be best maintained by a combination of even-aged and selection management which removes mature and poor-quality trees for wood products while providing for establishment of new trees by natural or artificial regeneration (Myers 1974). Understory vegetation can be used as a source of food for wildlife and domestic livestock. Sometimes though, conflicts may arise among uses, and one use can be detrimental to the others. The extent of conflict needs to be evaluated to determine how damaging effects can be minimized or eliminated without significantly hampering that use.

One conflict between uses reported for ponderosa pine forests concerns the damage to small trees from cattle grazing. Results of studies reported here show that protection of natural and artificial pine regeneration from cattle grazing is not necessary, provided the grazing intensity is prescribed to use 40% or less of the principal bunchgrasses, forested ranges are in fair to good condition, and natural watering places are available or supplemental water hauled to assure an adequate water supply for livestock.

Figure 1.—Scenic, open-growing ponderosa pine forests in central Colorado provide timber products, forage for wild and domestic animals and opportunities for outdoor recreation.

Introduction

Published recommendations for resolving the cattle grazing versus tree regeneration conflicts on ponderosa pine-bunchgrass ranges in the Southwest vary from careful use for grazing, without serious damage to pine reproduction, to complete protection and withdrawal of forested rangelands from grazing for an extended period. Hill (1917) concluded that overgrazing was the cause of the most severe damage in ponderosa pine forests in Arizona and New Mexico. He concluded that cattle do not browse pine reproduction by preference and overgrazing should be avoided. Where palatable forage is sufficient, regeneration will not suffer seriously from grazing.

Summarizing results of a 10-year study of damage to pine reproduction on southwestern bunchgrass ranges, Cassidy (1937) emphasized that thirst was another major factor influencing browsing of seedlings, and that other forms of injury by cattle were "negligible on a reasonably stocked range." He cautioned that prior to summer rains in some areas, livestock populations might have to be reduced to one-third of those which normally graze a given range. Cooperrider (1939) stated that livestock forage areas should be provided which are accessible from watering places to control browsing of seedlings. He also recommended providing additional water, if needed, on poorly watered ranges.

Pine seedlings usually recovered from the effects of browsing, except where poor management practices led to recurrent browsing over long periods. Pearson (1950) found that cattle in Arizona did not appreciably browse young pines after about July 15. He concluded that, if deferred until July 15, cattle grazing could be used effectively to: "(1) utilize the bunchgrasses in their most palatable state without danger of pine browsing; (2) encourage pine regeneration by relieving grass competition; and (3) lower the fire hazard by reducing the volume of dry grass carried over to the succeeding fire season."

Comparing effects of grazing on natural and artificial regeneration, Sampson (1926) recommended that cattle could be grazed at moderate rates without injury to reproduction on cutover forests, but cattle should be excluded from areas that were artificially planted to timber species.

Heerwagen (1954) discussed the compatibility of both timber use and grazing use in the ponderosa pine forests of the front range of the central and southern Rocky Mountains. He emphasized the need to include both timber and grazing values in developing sound land use policies for the area. While warning against excessive grazing use, he concluded that moderate grazing, with provisions to avoid livestock concentration, helped reduce herbaceous competition and fire hazard while causing only negligible damage to pine reproduction.

More recent guides for ponderosa pine regeneration in the Southwest recommend fencing to exclude cattle from plantations for the first 5 or 6 years after planting (Schubert et al. 1970). These guides also recommend that, after this initial establishment period, grazing should be deferred until the summer wet season in mid-July, or as long as seedling terminals are in reach of the cattle. Schubert (1974) further modified these guides to exclude livestock from all regeneration areas. He concluded, however, light cattle grazing during the summer wet season may cause little damage once seedlings are about 1 foot (0.30 m) tall.

The purpose of the present study was to evaluate these recommendations and conclusions as they apply to ponderosa pine-bunchgrass rangeland in central Colorado.

Study Area and Methods

The study was conducted in two phases at the Manitou Experimental Forest, 28 miles (45 km) northwest of Colorado Springs, Colo.

Climate at the Experimental Forest is typical of much of the Front Range of Colorado. Precipitation averages about 15.75 inches (400 mm) per year. About three-fourths of this amount is received from April through August. July is normally the wettest month with rainfall averaging 3.33 inches (85 mm). Winters are cold, but open. Except on north slopes, snowfall accumulation is low in most years on areas occupied by ponderosa pine. Substantial accumulations are normally restricted to north slopes or higher elevations where Douglas-fir (*Pseudotsuga menziesii* var. *glauca* (Beissn.) Franco) or lodgepole pine (*Pinus contorta* subsp. *latifolia* (Engelm. ex Wats.) Critchf.) is the dominant tree species.

In phase 1, grazing damage by yearling cattle was assessed in relation to grazing intensity from 1941 to 1948. The ponderosa pine-bunchgrass rangelands were under study at that time to investigate the effects of light (10-20%) use, moderate (30-40%) use and heavy (over

50%) cattle use measured in percent of current growth of the principal bunchgrass vegetation removed from these ranges. Ranges were usually grazed June 1 to October 31 each year. Comprehensive analyses of this work is reported by Johnson (1953) and Smith (1967). Records were kept on 40 seedlings under each grazing intensity.

Following completion of the first phase of the study, stands on 1,200 acres (485.62 ha) were cut over using concurrent methods prescribed by Myers (1974). Variability within and among stands in the treatment area required application of six cutting methods: (1) thinning to reduce density of even-aged groups and stands, (2) improvement cutting to remove diseased, dying, and poor quality trees, (3) clearcutting to remove patches of badly diseased trees, (4) seed cut of shelterwood to establish natural regeneration over an area large enough to be treated as a stand, (5) final cut of shelterwood to release an adequately stocked understory, and (6) group selection to obtain natural regeneration in small areas. Total sawtimber volume removed during the winter months of 1967 and 1968 was about 2.8 million board feet. Thinning dense advanced regeneration and improvement cutting to remove poor quality and diseased trees produced about 1,000 cords of firewood during the next several winters. Stand basal area after treatment averaged 40 to 45 square feet per acre (9.18 to 10.33 m^2 per ha). The irregular structure typical of many of these stands is shown in figure 2. Patches heavily infested with dwarf mistletoe (*Arceuthobium vaginatum* subsp. *cryptopodum* (Engelm.) Hawks. & Wiens) were clearcut or isolated from adjacent uninfested stands by clearcut buffer zones to retard the spread of this parasite (fig. 3).

Figure 2.—Partial cuttings left irregular stands of ponderosa pine with a good bunchgrass understory and some natural regeneration. Residual basal area averaged 40 to 45 square feet per acre (9.18 to 10.33 m^2 per ha).

Figure 3.—Some patches were nearly clearcut to remove badly damaged dwarf mistletoe infested trees. Forage on these areas is readily grazed by livestock.

Phase 2 of the study was carried out in conjunction with a comparison of rotation and season-long grazing which was already in progress on these cutover forested rangelands (Currie 1978). For this comparison, the area was fenced into 12 pastures of 100 acres (40.47 ha) each. The pastures were assigned into two replications of six pastures each. Three of the pastures in each replication were grazed by Hereford cows and calves on a rotational basis. Fences between three adjacent pastures were dropped to obtain 300-acre (121.41-ha) pastures for season-long grazing. Water tanks were installed in the pastures to insure adequate water supply. These pastures were grazed for a 40-day rotation period between June 15 and October 15 each year, or season-long for 120 days between these dates. A crossover design was used, so that an area which was grazed season-long 1 year would be rotationally grazed the following year. Thus ponderosa pine regeneration was subjected to a concentration of animals for a short time under rotation grazing in 1974 and 1976 and for the entire summer

period under season-long grazing in 1975. Pastures were stocked to utilize forage at the moderate rate, 30% to 40% use of the principal bunchgrasses, recommended by Smith (1967).

To assess damage to artificial regeneration, 12,000, 2-0 bareroot ponderosa pine seedlings[2] were planted on an area of about 10 acres (4.05 ha) which had been clearcut to control dwarf mistletoe. The seedlings were planted in the spring of 1974 at about a 6-foot (1.83-m) square spacing. Before cattle were placed in this pasture on June 15, 1974, 750 seedlings were systematically selected along transect lines, and each was marked for relocation following grazing by placing a golf tee with a strip of plastic marking ribbon in the ground adjacent to the seedling (fig. 4). Because some mortality occurred following spring planting, a notation was made whether each seedling was alive or dead. Also, a record was made as to whether or not each live seedling had any damage or had been browsed by some animal other than cattle. Immediately following the grazing season, the seedlings were relocated, and the same information was recorded. These observations were repeated in 1975 and 1976.

To assess damage to natural regeneration, previously established 100-foot (30.48-m) square gridlines were used as transect lines in a 23-acre (9.31-ha) stand used to study spatial pattern and development of individual trees. Naturally established seedlings along the transect gridlines were marked, and observations were made as described previously. Observations were made for only 1 year because of low establishment and mortality rates each year. This pasture was grazed season-long in 1975.

[2]*Tree seedlings for the study were obtained from Mt. Sopris Nursery, Carbondale, Colo.*

Figure 4.—Individual seedlings were marked with a golf tee and plastic ribbon along a number of transect lines to evaluate grazing and other damage to the trees.

Results and Conclusions

Results from the first phase of the study show seedling damage was greatest with a heavy rate of grazing (table 1). In the 8 years from 1941 to 1948, 83% of seedlings sustained grazing damage. Approximately four (10%) of the seedlings were damaged by cattle grazing each year. Seedlings subjected to recurrent browsing usually suffered damage to both lateral and terminal buds (fig. 5). Such seedlings usually survived but were hedged or otherwise deformed. Seedlings which were not recurrently damaged developed normal form (fig. 6).

Table 1.—Total seedlings damaged by cattle grazing and rabbits or rodents on ponderosa pine reproduction during an 8-year period (1941-49), Manitou Experimental Forest, Colorado

Rate of use	Average seedling height		Cattle damage	Rabbit/ rodent damage[1]
	1941	1949		
	Inches		*Number*	
Heavy	8.4	34.2	29	10
Moderate	11.1	38.7	4	7
Light	9.2	51.4	6	13

[1]*Forty seedlings were marked and sampled under each grazing intensity.*

Damage was less severe with either moderate of light rates of grazing. With moderate grazing within the pastures, only four seedlings were damaged during 8 years. With light grazing, six seedlings were damaged during this period. Rodents and rabbits damaged more of the reproduction than cattle on these treatments. The average height growth was greater under light grazing intensity than under both heavy and moderate rates which were about equal.

The recommendation to defer grazing in plantations for 5 or 6 years would be difficult to follow in central Colorado under multiple-use considerations. Partial cutting practices in ponderosa pine forests are aimed at main-

Figure 5.—Both lateral and terminal buds were often browsed on seedlings subjected to recurrent damage under heavy grazing intensity.

Figure 6.—Many seedlings were severely hedged by recurrent browsing under heavy grazing intensity. Other seedlings which were not recurrently browsed recovered from damage and developed normal form.

taining a variety of stand structures. Large contiguous areas are rarely regenerated. Thus it is difficult to fence cattle out without unreasonable expense. Deferring an entire ponderosa pine-bunchgrass range would also be restrictive. As shown in table 1, height growth of the ponderosa pine regeneration averaged only 27.6 inches (70.10 cm) for 8 years on moderately grazed ranges and 42.2 inches (107.19 cm) on lightly grazed ranges. Neither of these growth increments would put terminal buds out of reach of cattle for perhaps 10 or more years.

Phase 2 of the study showed that in this instance cattle grazing was not a major source of damage to naturally established seedlings (table 2). With light to moderate rates of use and a grazing season of mid-June to mid-October in this summer rainfall area, damage from grazing amounted to less than 1%. Damage from all causes was 5%, with total mortality being 2% for the 23-acre (9.31-ha) area sampled.

Damage and mortality was much more severe in the area where 12,000 nursery seedlings were planted (table 3). Most of the damage and mortality was from causes other than grazing. This was true even though the plantation seedlings did not receive any protection or deferment in pastures stocked with cattle. During the study, four seedlings were browsed the first year, two the second, and none the third. This included trampling damage where it could be discerned.

It should be noted that 176 seedlings showed some type of damage prior to any livestock

Table 2.—Survival, mortality, effects of grazing and other damage on naturally established ponderosa pine seedlings (1975), Manitou Experimental Forest, Colorado

Grazing period	Live seedlings	Dead seedlings	Damaged seedlings	Seedlings grazed by cattle	Total damage	Total mortality
	Number				*Percent*	
Before grazing	118	1	3	0	2	<1
After grazing	117	2	6	1	5	2

Table 3.—Survival, mortality, effects of grazing and other damage on planted ponderosa pine seedlings, Manitou Experimental Forest, Colorado

Year and grazing period	Live seedlings	Dead seedlings	Damaged seedlings	Seedlings grazed by cattle	Total damage	Total mortality
	Number				*Percent*	
1974						
Rotation July 25 - Sept. 5						
Before grazing	674	76	176	3	23	10
After grazing	590	160	139	7	19	21
1975						
Season-long June 15 - Oct. 15						
Before grazing	531	219	175	7	23	29
After grazing	485	265	153	9	20	35
1976						
Rotation June 15 - July 26						
Before grazing	370	380	129	9	17	52
After grazing	370	380	112	9	30	51

being put in the pastures (table 3). This damage included breakage and stem damage by nursery and planting procedures, insect damage, and clipping by rabbits and small rodents. The number of damaged seedlings tended to decrease over the 3-year period, but this was because seedlings were dying and are accounted for in the mortality column.

Approximately 50% of the planted seedlings died during the first 3 years. This figure is higher than for Arizona, where mortality is expected to be 30-40% during the first decade (Schubert 1974). It is closer to the 50% expected by the time they reach a diameter of 5 inches (12.7 cm). Because of higher mortality in central Colorado, proper nursery and planting procedures must be maintained to assure a good stand of new trees. Pearson (1950) recommended planting at least 1,000 seedlings per acre (2,471 per ha) to produce a stand with satisfactory sawtimber form. Because of higher mortality observed in central Colorado, 1,200 seedlings per acre (2,965 per ha) should be planted at a maximum 6-foot (1.83-m) square spacing. An alternative practice is to plant 500 to 600 seedlings per acre (1,236 to 1,483 per ha) initially and to replant areas of high mortality later[3].

Literature Cited

Cassidy, H. O. 1937. How cattle may use cutover ponderosa pine-bunchgrass ranges with minimum injury to reproduction. Res. Note 15, 3 p. Southwestern For. and Range Exp. Stn., For. Serv., U.S. Dep. Agric., Tucson, Ariz.

Cooperrider, D. K. 1939. Grazing and western timber production. Range Res. Semin. [Ephram, Utah, July 1939] Proc. p. 375-380.

Currie, P. O. 1978. Cattle weight gain comparisons under seasonlong and rotation grazing systems. Proc. First Int. Rangeland Congr., Soc. Range Manage., Denver, Colo.

Heerwagen, A. 1954. The effect of grazing use upon ponderosa pine reproduction in the Rocky Mountain area. Soc. Am. For. [Milwaukee, Wis., Oct. 1954] Proc. p. 206-207.

Hill, R. R. 1917. Effects of grazing upon western yellow-pine reproduction in the national forests of Arizona and New Mexico. U.S. Dep. Agric. Bull. 580, 27 p.

Johnson, W. M. 1953. Effect of grazing intensity upon vegetation and cattle gains on ponderosa pine-bunchgrass ranges of the Front Range of Colorado. U.S. Dep. Agric. Circ. 929, 36 p.

Myers, C. A. 1974. Multipurpose silviculture in ponderosa pine stands of the montane zone of central Colorado. USDA For. Serv. Res. Pap. RM-132, 15 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Pearson, G. A. 1950. Management of ponderosa pine in the Southwest. U.S. Dep. Agric. Monogr. 6, 218 p.

Sampson, A. W. 1926. Grazing vs. forestry. Minority report of the Committee on Grazing, Soc. Am. For., J. For. 24:395-405.

Schubert, G. H. 1974. Silviculture of southwestern ponderosa pine: The status of our knowledge. USDA For. Serv. Res. Pap. RM-123, 71 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Schubert, G. H., L. J. Heidmann, and M. M. Larson. 1970. Artificial reforestation practices for the Southwest. U.S. Dep. Agric., Agric. Handb. 360, 25 p.

Smith, D. R. 1967. Effects of cattle grazing on a ponderosa pine-bunchgrass range in Colorado. U.S. Dep. Agric. Tech. Bull. 1371, 60 p.

[3]*Bennett, John E., Region 2, Division of Timber Management, April 20, 1978, personal communication.*

Currie, Pat O., Carleton B. Edminster, and F. William Knott. 1978. Effects of cattle grazing on ponderosa pine regeneration in central Colorado. Res. Pap. RM-201, 7 p. Rocky Mt. For. and Range Exp. Stn., For. Serv., U.S. Dep. Agric., Fort Collins, Colo.

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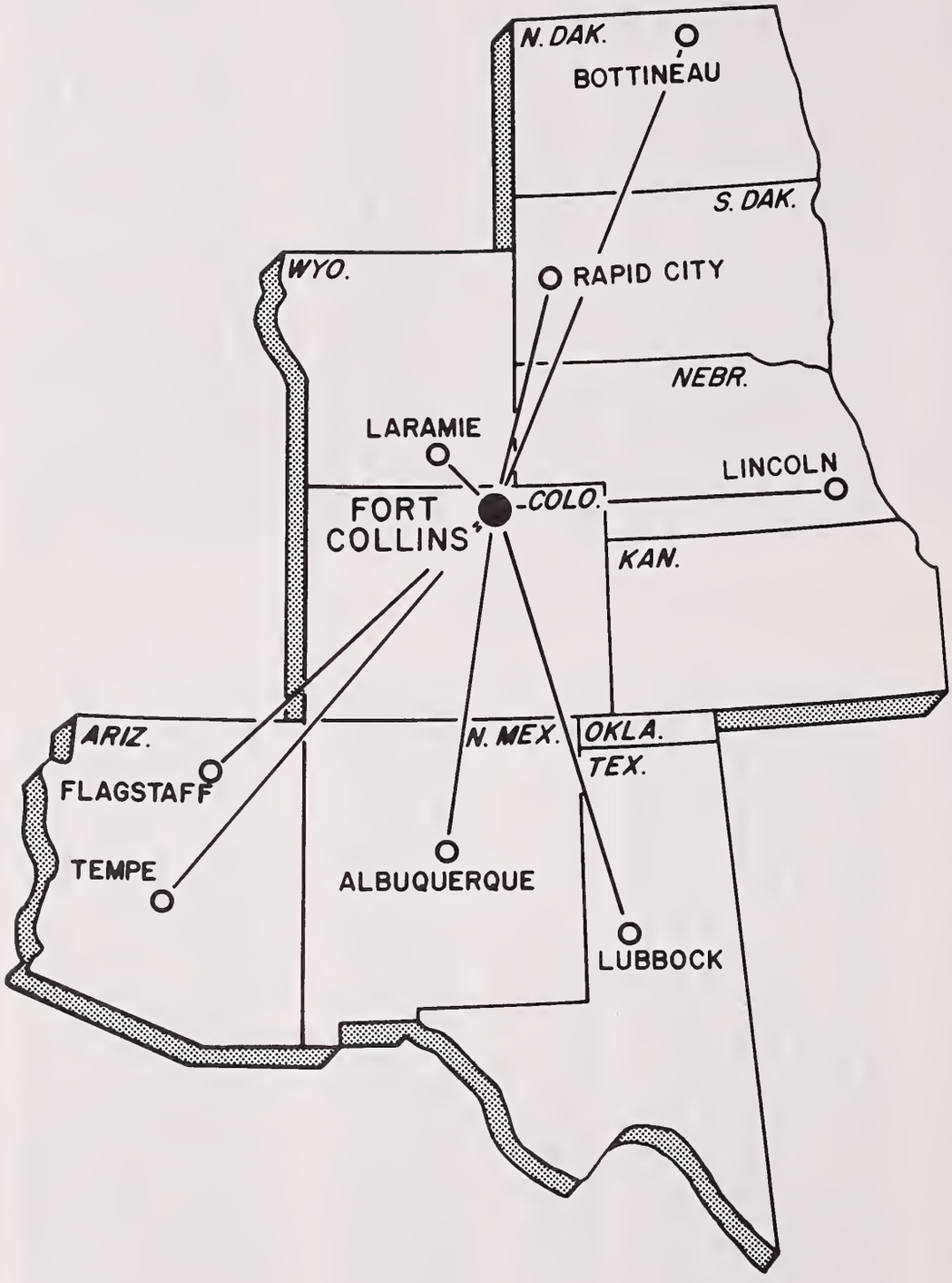

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